| Project | **IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16> |
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| Title | **Proposed Text of UL PHY Control Structure Section (15.9.2.5 Bandwidth Request Channel) for the IEEE 802.16m Amendment** |
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| Re: | "802.16m amendment text": IEEE 802.16m-08/053r1, "Call for Contributions on Project 802.16m Draft Amendment Content". Target topic: "11.9 UL PHY control structure, especially mapping". |
| Abstract | The contribution proposes the text of UL PHY control structure section to be included in the 802.16m amendment. |
| Purpose | To be discussed and adopted by TGm for the 802.16m amendment. |
| Notice | |
| Release | |
| Patent Policy | |

# Proposed Text of UL PHY Control Structure Section (15.9.2.5 Bandwidth Request Channel) for the IEEE 802.16m Amendment

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## 1. Introduction

The contribution proposes the text of UL PHY Control structure section to be included in the 802.16m amendment. The proposed text is developed so that it can be readily combined with IEEE P802.16 Rev2/D8 [1], it is compliant to the 802.16m SRD [2] and the 802.16m SDD [3], and it follows the style and format guidelines in [4].

## 2. Modifications to the SDD text

The text proposed in this contribution is based on subclauses 11.9.2.5 in the IEEE 802.16m SDD [3]. Details beyond the SDD are summarized in contribution [5].

## 3. References

[1] IEEE P802.16 Rev2/D8, "Draft IEEE Standard for Local and Metropolitan Area Networks: Air Interface for Broadband Wireless Access," Oct. 2008.

[2] IEEE 802.16m-07/002r7, "802.16m System Requirements"

[3] IEEE 802.16m-08/003r6, "The Draft IEEE 802.16m System Description Document"

[4] IEEE 802.16m-08/043, "Style guide for writing the IEEE 802.16m amendment"

[5] IEEE 802.16m-09/066, "IEEE 802.16m Uplink Control Channel Design Details and Updates", Motorola

# 4. Text proposal for inclusion in the 802.16m amendment

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## 15. Advanced Air Interface

## 15.9.2 UL Control channel

### 15.9.2.5. UL Bandwidth Request Channel

Contention based or non-contention based random access is used to transmit bandwidth request information on this control channel. Prioritized bandwidth requests are supported on the bandwidth request channel. In contention based random access, multiple mobiles may transmit bandwidth requests using the same physical resources at the same time.   In non-contention based random access, mobiles transmit bandwidth requests using dedicated physical resources that are allocated periodically or non-periodically to each mobile. Mobiles with higher priority are provided more frequent opportunities to send bandwidth request indicator in non-contention based random access.  In contention based random access, mobiles with higher priority can transmit bandwidth request using reserved random access code, and/or with more frequent opportunities to send bandwidth request indicator.

The bandwidth request procedure is described in Figure 1. A 5-step regular procedure (step 1 to 5) or an optional 3-step quick access procedure (step 1,4 and 5) may be supported concurrently. Step 2 and 3 are used only in 5-step regular procedure. In step 1, AMS sends a bandwidth request indicator for quick access that indicates to BS that the mobile requesting for additional UL bandwidth allocation. The bandwidth request indicator applies one bit on/off keying, with 1 implying requesting for additional UL bandwidth, and 0 for no-request.   Additional information such as AMS addressing and/or request size (FFS) and/or uplink transmit power report (FFS), and/or QoS identifiers (FFS) are transmitted in step-3 using bandwidth request message, and the ABS may allocate uplink grant based on certain policy.

The 5-step regular procedure is used independently or as a fallback mode for the 3-step bandwidth request quick access procedure.   For legacy mode, only the 5-step regular procedure is used.   The AMS may piggyback additional BW REQ information along with user data during uplink transmission (step 5) or with UL fast feedback control message. In step 2 and step 4, ABS may send message to acknowledge the reception status.
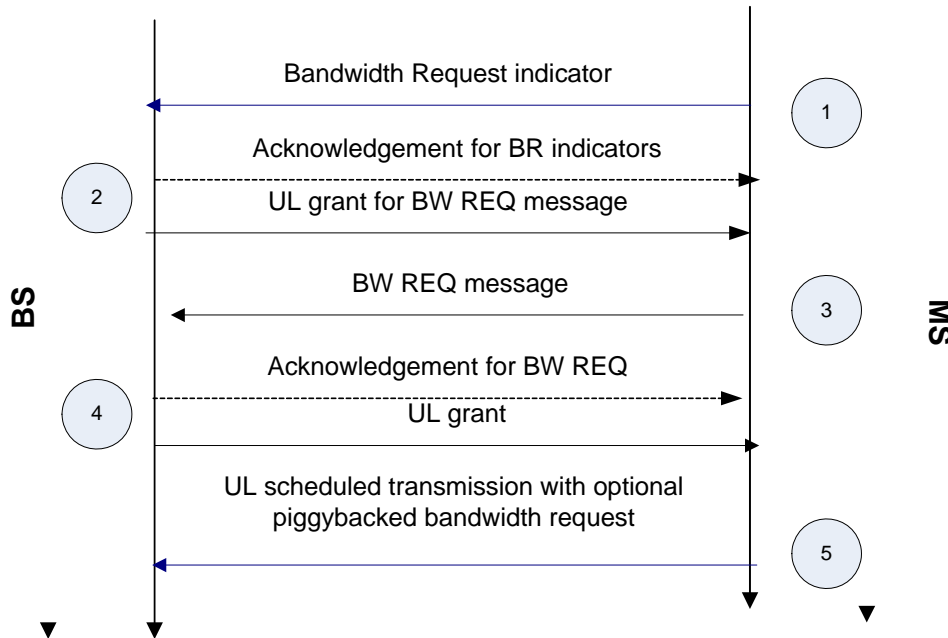
Figure 1 Bandwidth Request Procedure

15.9.2.5.1. Multiplexing with other control channels and data channels

The bandwidth request channel starts at a configurable location with the configuration defined in a DL broadcast control message. Non-contention based bandwidth request channels are allocated periodically or non-periodically for MS. The bandwidth request channel is FDM with other UL control and data channels.

15.9.2.5.2. PHY structure

For non-contention based random access bandwidth request, the minimum resource unit is a UL feedback mini-tile (FMT) which contains 2 contiguous subcarriers by 6 OFDM symbols. Twelve non-contention based random access bandwidth request indicators are multiplexed together using a mixture of FDM/TDM/CDM in each FMT, and repeat for three times in three distributed UL DRU tiles. The PHY structure of a fast feedback channel for green field mode is shown in Figure 2, and for legacy mode in Figure 3. In allocating the twelve non-contention based random access bandwidth request indicators, the twelve orthogonal sequences in Figure 4 are allocated to the twelve indicators sequentially. AMS transmits a corresponding sequence to request for UL bandwidth, or no-transmission for non bandwidth request.

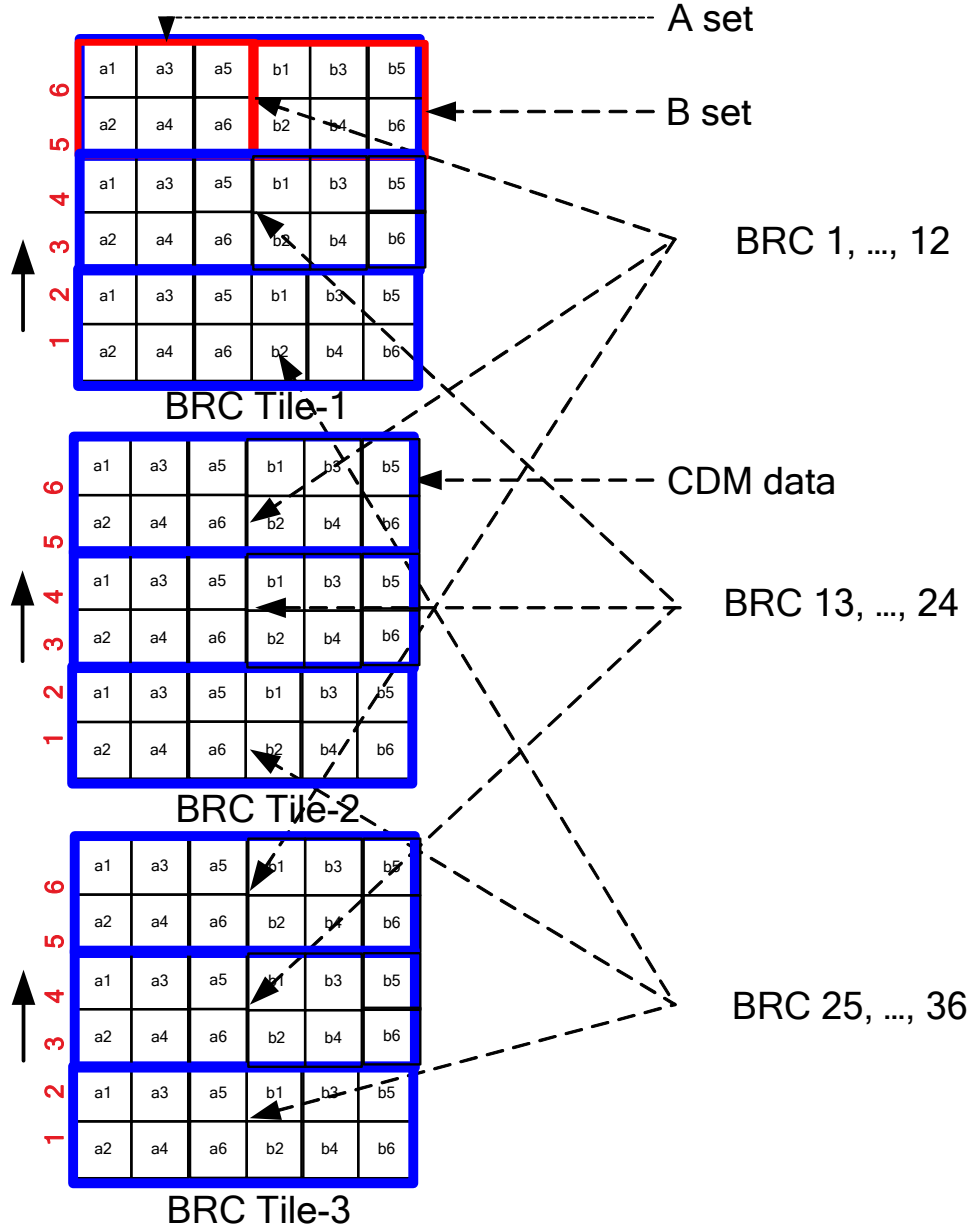The PHY structure of contention based random access bandwidth request is TBD.

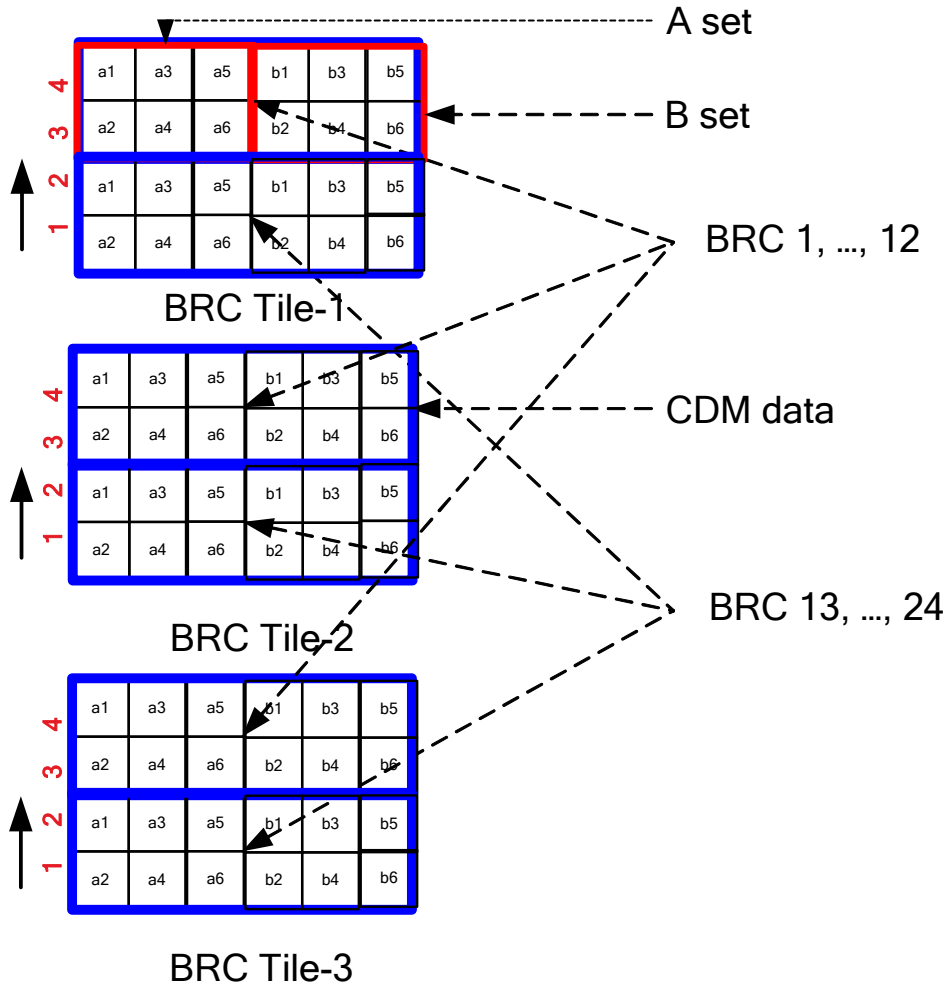Figure 2.   UL Non-contention Based Bandwidth Request Indicator Data Tone Allocations (green field mode)

Figure 3.   UL Non-contention Based Bandwidth Request Indicator Data Tone Allocations (legacy mode)
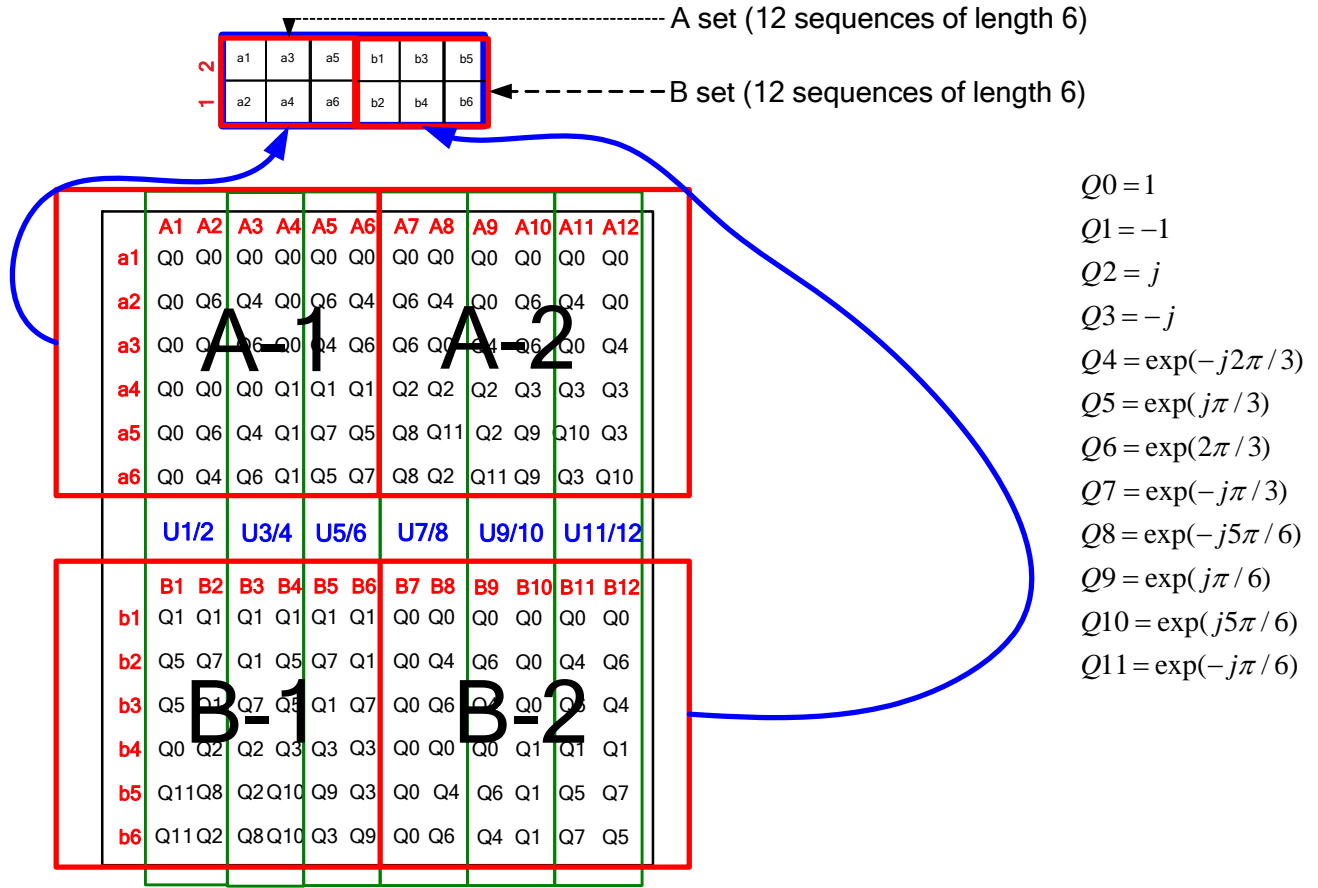
Figure 4. Twelve orthogonal complex sequences for 12 bandwidth request indicator

$Q0 = 1$
$Q1 = -1$
$Q2 = j$
$Q3 = -j$
$Q4 = \exp(-j2\pi/3)$
$Q5 = \exp(j\pi/3)$
$Q6 = \exp(2\pi/3)$
$Q7 = \exp(-j\pi/3)$
$Q8 = \exp(-j5\pi/6)$
$Q9 = \exp(j\pi/6)$
$Q10 = \exp(j5\pi/6)$
$Q11 = \exp(-j\pi/6)$

If there are multiple contiguous UL subframes within one frame, the UL bandwidth request tiles are allocated in time dimension first in order to improve the coverage and to reduce the MS transmit power as shown in Figure 5. Further, subframe based frequency hopping of the tiles can be applied to improve the frequency diversity.
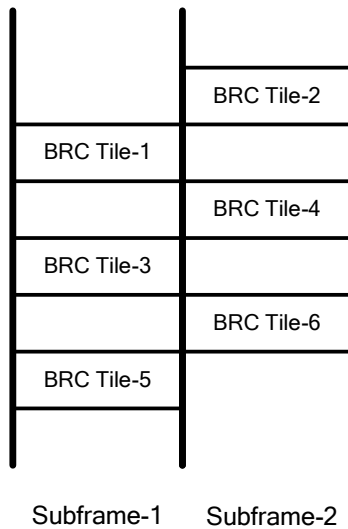


Figure 5. Non-contention based bandwidth request tile allocations

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